# Oil and Natural Gas Resources of the Wattenberg Field, Denver Basin, Colorado

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**Significant quantities of oil and gas have been produced from the Wattenberg field, Denver Basin, Colorado since its discovery in 1970. Cumulative production from all rock formations in the field is listed as 1.5 trillion cubic feet of gas (TCFG), 64.8 million barrels of oil (MMBO), and 12.8 million barrels of water (MMBW) (Petroleum Information Production Data through 1997). More than 779 billion cubic feet of gas (BCFG), 8.4 MMBO, and 6.6 MMBW have been produced from the Cretaceous age D and Muddy (J) Sandstone in the field (Petroleum Information Production Data through 1997). Estimated ultimate recovery (EUR) from current D and Muddy (J) Sandstone wells is more than 1.27 trillion cubic feet of gas (TCFG). Based on production data, estimated field life is greater than 30 years. More than 1,800 gas wells produce from**

**the Muddy (J) Sandstone (Figure 1). Also shown on figure 1 are five major wrench fault zones (WFZ) that were active millions of years ago, and influence present-day reservoir production. The field area is thermally mature for gas generation; source is organic-rich marine shales that bound the D and Muddy (J) Sandstone (Higley and others, 1992).**

**The Muddy (J) Sandstone was deposited about 97 million years ago in mostly marine and distributary channel (river) depositional environments. These shallow marine, beach, and river sandstones and mudstones were located along the Cretaceous epicontinental seaway, which was an inland ocean that extended from the Gulf of Mexico to the Arctic Ocean. The Muddy (J) Sandstone forms prominent tan-colored sandstone hogbacks that border most of the western boundary of the Denver**

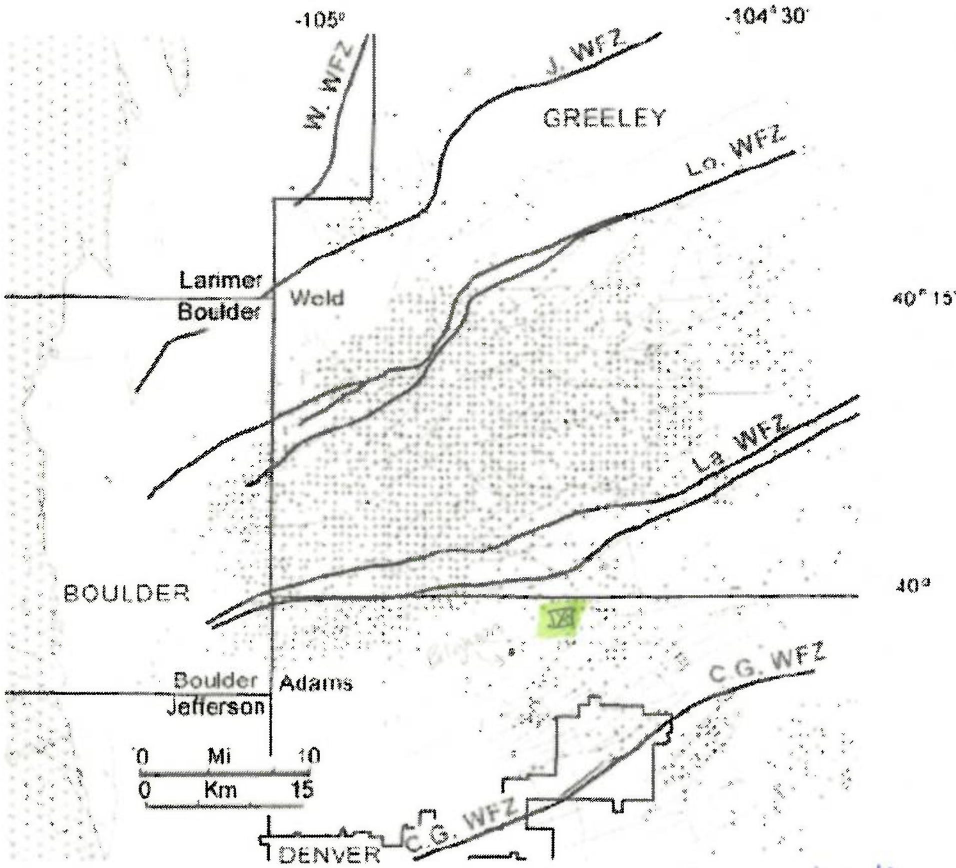


Figure 1. Distribution of gas wells (dots) in the Wattenberg field area, Denver Basin, Colorado. Wrench fault zones (WFZ) (Weimer, 1996) are thick lines. Fault zones are Windsor (W. WFZ), Johnstown (J. WFZ), Longmont (Lo. WFZ), Lafayette (La. WFZ) and Cherry Gulch (C.G. WFZ). Greatest gas production is concentrated between the Longmont WFZ and the Lafayette WFZ. Thin brown lines delineate faults along the Front Range uplift (V pattern) and hypothetical faults of Weimer (1996) in the field area.

**Basin; it is from these sandstones that most of the oil is produced across the basin. The rocks that comprise the gas reservoir at Wattenberg do not form hogbacks west of the field. They are mostly thin, interbedded mudstones and very-fine-to-fine-grained sandstones that lack the structural integrity to form the ridges.**

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**Average well spacing for D and Muddy (J) Sandstone gas wells (Petroleum Information WHCS data, 1997) is 160 acres. This spacing will probably decrease to 40 acres in some areas of the field. The primary reason for this decrease is to recover a greater percentage of the original gas in place; only about 25 to 33% of the original gas in place is drained by each well. Basically, the sandstone "sponge" cannot be wrung dry. Ultimate recovery from existing wells is about 2 to 2.5 BCFG for each 160 acre tract. Much of the infill would be accomplished by deepening existing wells that are much shallower. Average well spacing is 40 acres for most of the overlying Upper Cretaceous-age Niobrara Limestone, Codell Formation, Hygiene (Shannon) Sandstone, and Terry (Sussex) Sandstone oil and gas production.**

**The fault zones that were active in the past influence present-day production, as indicated by the highly irregular distribution of gas production across the field (Figure 2). Variation in gas production suggests some faults were sealing, whereas others were open to fluid flow. Vertical offset of faults is minor with the exception of some segments of the wrench fault systems that border and cut the field. Extreme heterogeneity of production in the Wattenberg field results from numerous processes, including vertical and lateral movement along fault zones. The Longmont and**

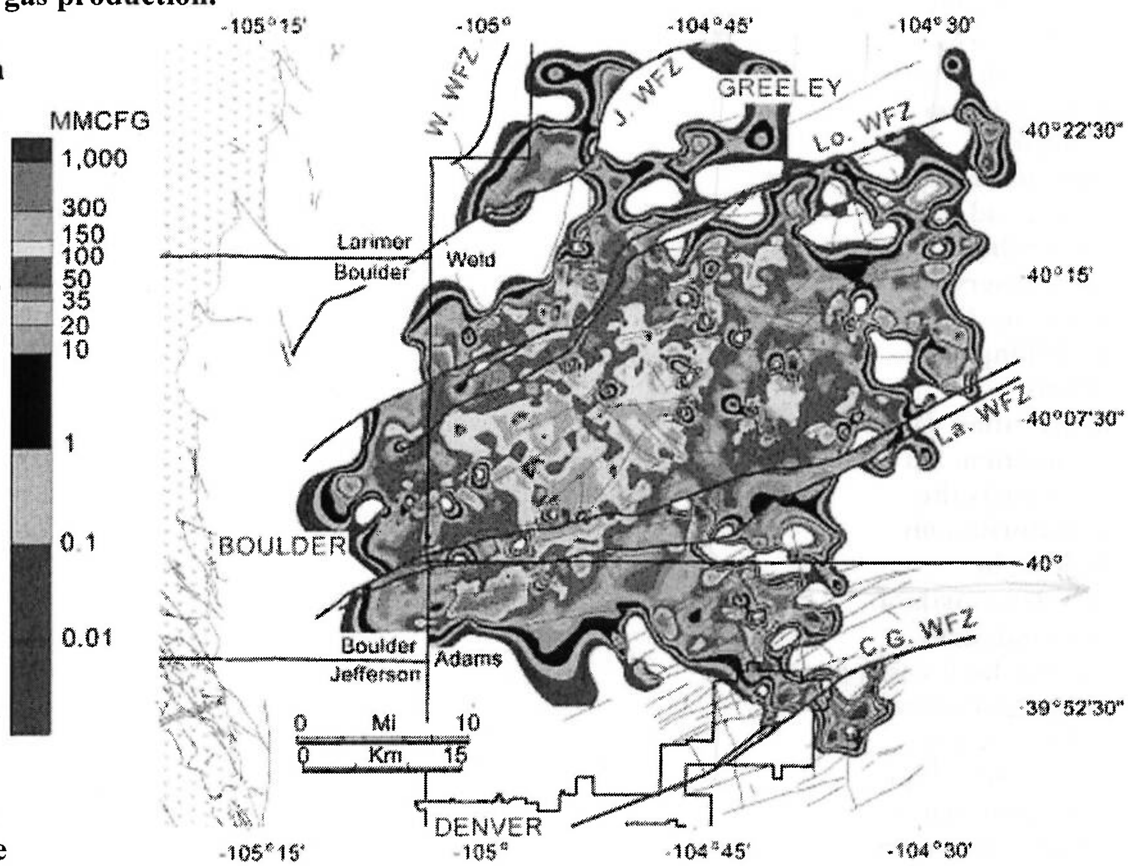


Figure 2. Distribution of the best-12-months of gas production for about 1,800 wells across the Wattenberg field. Greatest production is along a northeast-trending belt proximal to the field and basin syncline. Major wrench fault zones from Weimer (1996) are Windsor (W. WFZ), Johnstown (J. WFZ), Longmont (Lo. WFZ), Lafayette (La. WFZ), and Cherry Gulch (C.G. WFZ). Faults along the Front Range (V pattern) and hypotetical faults within the field (Weimer, 1996) are shown as thin brown lines.

**Lafayette wrench fault zones bracket the region of greatest gas production. Gas production in the western half of the field extends north and south of these fault zones. The eastern half of the field has limited gas production outside these wrench faults. This may result from sealing behavior that limits lateral migration of gas, leakage of gas along open sections of the faults, and lower permeability of some reservoir intervals. Density of drilling also affects distribution of production. An example is the moratorium on drilling in Greeley, north of the Longmont wrench fault zone; although existing wells here are mostly dry holes (non-productive) because rocks are cemented by silica. The western seal of the field was largely erosional truncation of the primary reservoir interval combined probably with mountain front faulting (Weimer, 1996).**

**Heterogeneity also results from variation in depositional environments of producing intervals. Increased gas production in the southeast corner of the field results largely from greater porosity and permeability associated with fine-to-medium grained sandstones deposited in a northwest-trending distributary channel system. This is also a primary conduit for gas migration outside the area of source rocks that are thermally mature for gas generation. The Cherry Gulch wrench fault zone, located in this area, did not appear to limit lateral migration of hydrocarbons.**

## REFERENCES


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***U.S. Department of the Interior, U.S. Geological Survey***
***URL:http://rockyweb.cr.usgs.gov/frontrange/energy/petroleum_resources/petroleum_resources.htm***



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